**REVIEW OF AVAILABLE STUDIES THAT ADDRESS IMPACTS TO GOLDEN-CHEEKED WARBLER (GCWA) DUE TO HIGHWAY NOISE (ROAD, CONSTRUCTION).**

**EXECUTIVE SUMMARY**
**on behalf of the Scientific Advisory Committee (BCCP)**

**C. CRAIG FARQUHAR***

I was asked as a member of the Scientific Advisory Committee advising the Balcones Canyonlands Conservation Plan Coordinating Committee to respond to a request from City of Austin Councilmember Leslie Pool to examine studies related to 'effects of road noise on Golden-cheeked Warbler (GCWA).' The totality of scientific literature on road noise and its effects on animals is very large and notoriously problematic (Brumm 2013). There are very few thorough, multi-season studies on this subject related to birds, including GCWA (but see Blickley et al. 2012a, b). Such studies, if scientifically rigorous, would assist natural area managers, policy makers and conservationists in understanding impacts to conservation and preservation of this, or any, species. Texas Parks and Wildlife Department has previously commented on the environmental impacts to habitat due to construction of SH45 potentially affecting GCWA and other taxa (see TPWD 2015).

I initiated my review by examining a report ("Final Draft: State Highway 45SW: 2014 Golden-cheeked Warbler Technical Report" SWCA 2014) by the consultant firm, SWCA, and funded by the Texas Department of Transportation (TxDOT). SWCA (2014) cites two studies (Lackey et al., 2011; Pruett et al. 2014) that pertain to impacts to GCWA due to highway noise. As I could not avail myself of Pruett et al. (2014; an interim report comprising part of Long et al. 2015) I mainly focus on Lackey et al. (2011; Hwy 183) but also review Long et al. (2015) as it was conducted along Hwy 71 (as were Pruett et al. 2013, Davis et al 2014, Pruett at al 2014). Additionally, I reviewed Benson (1995) as it has been cited numerous times in the above literature and probably was the first to examine road noise and GCWA. In this summary, I note that all the studies reached the same general conclusion: highway noise (construction, vehicular) has little to no impact on GCWA population health and viability. However, due to limited sample sizes, use of superficial methods (e.g., Vickery Reproductive Index for breeding success, Minimum Convex Polygon for territory assessment) and overly ambitious design (e.g., Long et al. 2015) I contend that the above papers leave open questions about methodology, response variables, analyses and inferences. In this light, the conclusions reached in these papers are not unequivocal; they all have consequential flaws, in my opinion. Therefore, while they may serve as preliminary assessments in some regard they should be used with great caution, or not all, to inform conservation decisions or policy. Moreover, findings of 'no impact' or 'no effect' should be considered as less suitable alternative inferences to the more scientifically defensible 'failure to detect effect/impact.' Thus, had other designs and methodologies been utilized then different outcomes (e.g. evidence of effect/impact to GCWA due to highway noise) cannot be ruled out.

Importantly, all the reports focusing on road noise impacts to GCWA reviewed here, except two which did not mention funding source but were in the same study areas at the same time, were funded by TxDOT. An entity seeking to determine whether any of its own activities are likely to impact a federally endangered species should not also be the direct source of funding for research undertaken to evaluate such impacts. An analogy can be made to the automobile industry where the overseeing Vehicle Certification Agency receives the majority of its funding from automakers, clearly this is viewed as a conflict of interest (see Guardian 2015). This funding connection should at least increase vigilance

*perspectives presented here are strictly those of the author not those of Texas Parks and Wildlife Department.

regarding claims of 'no impact or no effect.' Results should be compared to those funded independently, by independent groups, but this was not the case here. Further, regarding the fact that funding for all of the above highway impact studies related to Hwy 71 and Hwy 183 was awarded to Texas A&M University (Institute of Renewable Natural Resources) which has made publicly available (Texas A&M IRNR 2015) its strong support for the current Petition to Delist the Golden-cheeked Warbler calls into question IRNR's ability to examine these important conservation issues in an unbiased manner.

**Studies on impacts to GCWA from road noise cited in SWCA (2014):**

Lackey, M. A., M. L. Morrison, Z. G. Loman, B. A. Collier, and R. N. Wilkins. 2011. Experimental Determination of the Response of Golden-Cheeked Warblers (*Setophaga chrysoparia*) to Road Construction Noise. Ornithological Monographs, 74:91-100. Funded by TxDOT (#7-7XXIA001). US HWY 83 study area. **Reviewed here.**

Pruett, H.L., H.A. Mathewson, and M.L. Morrison. 2014. Study of the potential impacts of highway construction on selected birds with emphasis on the golden-cheeked warbler: annual report 2013. Texas A&M Institute of Renewable Natural Resources. Prepared for the Texas Department of Transportation, Austin, Texas, under contract no. 14-2XXIA004.
**--CANNOT LOCATE**, not included in this review, but probably similar if not same dataset as that in Long et al (2015) below – note same exact TxDOT contract. Perhaps also related to Pruett et al (2013) and Davis et al (2014) below. If so, then likely study area was: Barton Creek Habitat Preserve; US HWY 71, near Southwest Pkwy, and part of Long et al. (2015).

**Other studies reviewed here from relevant literature:**

Benson, R. H. 1995. The effect of roadway traffic noise on territory selection by Golden-cheeked Warblers. Bulletin of the Texas Ornithological Society 28:42–51. Funding "provided by Texas Department of Transportation." Study area: Meridian State Park.

Lackey, M. A., M. L. Morrison, Z. G. Loman, B. A. Collier, and R. N. Wilkins. 2012. Experimental determination of the response of golden-cheeked warbler (*Setophaga chrysoparia*) to road construction noise. Ornithological Monographs 74:91–100. Funded by TxDOT (#7-7XXIA001). Study area: US HWY 83, Real/Uvalde Cos on Big Springs Ranch.

Long, A. M., J. L. Bosman, T. M. McFarland, H. A. Mathewson, and M. L. Morrison. 2015. Study of the Potential Impacts of Highway Construction on Selected Birds with Emphasis on the Golden-cheeked Warbler. Final Report, TxDOT Contract #14-2XXIA004. Study area: Barton Creek Habitat Preserve; US HWY 71, near Southwest Pkwy.

Pruett, H., H. Mathewson, and M. Morrison. 2013. Analysis of the Golden-cheeked Warbler in relation to construction activity along Highway 71. Field season 2013 summary for The Nature Conservancy. Study area: Barton Creek Habitat Preserve; US HWY 71, near Southwest Pkwy. No funding source mentioned.

Davis, K., H. Mathewson, and M. Morrison. 2014. Analysis of the Golden-cheeked Warbler in relation to construction activity along Highway 71. Field season 2014 summary for The Nature Conservancy. Study area: Barton Creek Habitat Preserve; US HWY 71, near Southwest Pkwy. No funding source mentioned.

**Extended review.**

**Regarding studies related to the effects on wildlife due to highway noise:**

The Federal Highway Administration (Corbisier 2003) indicated that sound levels from roadway traffic (not construction) noise "…typically range from 70 to 80 dB(A) at a distance of 15 meters (50 feet) from the highway." The papers reviewed here stated sound levels some 10-20 dB lower than these at their loudest. Dooling and Popper (2007), in an extensive review of gray and scientific literature related to highway noise and birds (funded as a third party by the California Department of Transportation through a consulting agency), identified four sources of impacts to birds from road noise (vehicular, construction):

1) *Stress and physiological effects*: could find "..no studies definitively identifying traffic noise as the critical variable affecting bird behavior near roadways and highways." (but see Ware et al. 2015 inferring loss of body condition due to road noise).
2) *Acoustic over-exposure*: "..more resistant to both temporary and permanent hearing loss or to hearing damage from acoustic overexposure than are humans and other animals that have been tested."
3) *Masking*: "Continuous noise of sufficient intensity in the frequency region of bird hearing can have a detrimental effect on the detection and discrimination of vocal signals by birds." This is supported by Ware et al. (2015).
4) *Dynamic Behavioral and Population Effects*: "Any components of highway noise that are audible to birds may have effects independent of and beyond the effects listed above."

To confidently address any of the above variables a thorough scientific examination of impacts to free-living animal populations is typically prohibitive in terms of labor and monetary outlay. Therefore, research studies, like those reviewed here, often employ surrogates of noise (e.g., recorded noise played back to birds, noise modeled from computer algorithms) and methods of assessment (e.g., territory shifts, reproductive index measures) that are themselves imprecise. Essentially, the framework of studies like these is to acknowledge up front that examining a bird's persistence when exposed to road noise is a difficult subject to address unequivocally, then narrow down the objectives to something more or less workable. But even this is a tall order, most research falls short of these expectations, due largely to 1) the degree of uncertainty regarding a useful (scientifically testable) response by the bird in determining effects that conclusively demonstrate negative (or any) impact its persistence, and 2) the scientific rigor (design, methodology, analyses, inferences, repeatability) stemming from the research.

Failure to find significant negative impact, overall, may indeed by the case given certain study designs and analyses employed, but in light of the many potential sources for error, and the potential to misinform policy-making, it behooves us to raise the bar of verifiable scientific evidence. Studies that fail to detect an effect, however, may easily be interpreted or used, erroneously, to signify 'no effect.' Just because a study failed to find an effect doesn't mean that one does not exist. This seemingly subtle difference can have profound influences. A misinterpretation like this may be convenient for entities wishing to avoid more intensive assessments (e.g., Section 7 consultations, state environmental reviews) but can easily have far-reaching consequences to conservation of the target species. Texas Parks and Wildlife Department has noted and commented for the record on the environmental impacts to many taxa and habitat (including that for GCWA) due to construction of SH45 potentially affecting GCWA (see TPWD 2015).

To summarize my review, the studies reviewed here dealing with GCWA and effects of road noise, although covering more than one breeding season, and involving notable effort in terms of billed researcher-hours, involve methodology lacking in elements of reliability as demonstrated in the scientific literature. Lackey et al. (2011, 2012), Pruett et al. (2013), Davis et al. (2014), and Long et al. (2015) employed the Vickery Reproductive Index (RI) for assessing 'reproductive success' (see also discussion of this term under the review for Lackey et al. 2011) and the Minimum Convex Polygon (MCP) method for assessing territory shifts due to road noise, these have known biases rendering them unreliable in assessing noise impacts. Reidy et al (2014) identified problems inherent in using the Vickery RI as opposed to intensive territory monitoring for understanding productivity in GCWA. Problems with MCP are discussed in comments on Lackey et al. (2011).

**Review of previous studies.**

**SWCA. 2014. Final Draft: State Highway 45SW: 2014 Golden-cheeked Warbler Technical Report; SWCA Project Number 27070-AUS. Texas Department of Transportation.**

p**. 1: probable conflict of interest, studies like these should be independently funded…** "SWCA Environmental Consultants (SWCA) was retained by the Texas Department of Transportation (TxDOT) to provide its professional opinion on the effect that construction and operation of State Highway 45SW (SH 45SW) could have on the federally listed endangered golden-cheeked warbler (*Setophaga chrysoparia*). "

**p. 3: claim of authority:** "SWCA performed a survey for the golden-cheeked warbler in the SH 45SW ROW in the spring of 2014. To our knowledge, this is the only survey for the warbler that has been conducted along the length of the ROW." Re-stated on p. 11: "To our knowledge, no survey of the complete SH 45SW ROW had been conducted for the golden-cheeked warbler prior to the spring of 2014. However, as discussed below, woodland in some sections of the SH 45SW ROW had been surveyed for golden-cheeked warblers, either directly or indirectly, in years prior to 2014.."

**p. 7. Establishes invalid premise:** "Comparison of recent aerial photography against historical aerial photography (e.g., such as that contained in soil surveys of Texas counties produced by the Soil Conservation Service of the U.S. Department of Agriculture, mostly in the late 1970s and early 1980s) and the mapping of golden-cheeked warbler habitat independently performed by Duarte et al. (2013), Morrison et al. (2010), Loomis-Austin, Inc. (2008), and Diamond (2007), all indicate that a considerably greater amount of potentially suitable warbler habitat is present on the landscape now than was present on the landscape in the 1970s and 1980s when examined by Wahl et al. (1990)."

**The above statement has been made many times by others but hard to reconcile comparing modern technology to that available in 1970s and 1980s.**

**p. 7. Invalid premise above used here to reach faulty conclusion:** "SWCA believes the results of the field surveys performed by Morrison et al. (2010) that enabled them to reach their population estimate indicate strongly that the golden-cheeked warbler population has been able to expand to take advantage of increased habitat availability." **BUT SEE BELOW ****

**** p. 17 SWCA expresses lack of confidence in Morrison et al (2010) model:** "Review of the Morrison et al. habitat modeling as shown on Figure 3 does cause SWCA to have some concern regarding the veracity of the model results in an urban/suburban landscape. The model identified many patches of potential warbler habitat to the north and northeast of the SH 45SW ROW, all of which are set within residential neighborhoods and all of which have seen little change in woodland cover between 2007–2008 and today based on review of recent aerial imagery available through Google Earth. While the model assigned low probabilities of occurrence to these patches, SWCA believes the actual probability of warbler occurrence in most, if not all, of those patches is zero and would not have identified them as potential warbler habitat. Thus, we wonder if the Morrison et al. (2010) model over-estimates probability of golden-cheeked warbler occurrence in a fragmented, urban/suburban landscape."

**p. 8: A priori bias, based on pure speculation, against potential harm/harassment due to TxDOT activities:** "Persistent occurrence of golden-cheeked warbler in these areas, as well as our own observations of warblers as described above suggest strongly to us that golden-cheeked warblers habituate to human activity and sources of anthropogenic noise." As support report cites Lackey et al (2011), Long et al (2015), and Pruett et al. (2014). In other words, why do this study if outcome is known?

**p. 19 confirmation bias, after examining previous surveys and habitat:** 'Consequently, it was the expectation of SWCA prior to the start of the survey that once again no golden-cheeked warblers would be found in this patch of woodland."

**p. 19, then this seeming contradiction of above:** "SWCA was unsure of what the result of the survey would be in woodland to the west of the Bliss Spillar property. SWCA had walked the LCRA transmission line easement past that section of the SH 45SW ROW several times the previous spring without having heard any golden-cheeked warblers in that direction, and so thought it possible that no warblers would be detected in the ROW. But, because a pair of golden-cheeked warblers had successfully fledged young on the Bliss Spillar property **[not sure which??]** the previous spring and the male of the pair could be heard singing from the LCRA transmission line easement, SWCA expected at a minimum that the survey would result in detection of a golden-cheeked warbler on the City of Austin property to the east."

"No other woodland in the SH 45SW ROW appeared to SWCA to have any reasonable likelihood of being occupied by golden-cheeked warblers. However, for the sake of thoroughness and absolute certainty, it was determined prudent to extend the warbler survey to all wooded portions of the SH 45SW ROW. Thus, all juniper- and oak-bearing woodlands occurring in the SH 45SW ROW were incorporated into the 2014 survey area, including the patch of live"…"… Therefore, woodlands occurring within 300 feet of the boundaries of the SH 45SW ROW were also incorporated into the 2014 survey area, with those lands surveyed from the ROW fence lines."

**In "Conclusion".. p. 23:** "A pair of golden-cheeked warblers nested on the Bliss Spillar property in 2013, but no warblers were found to occupy that property during surveys conducted in 2000, 2002, 2003, 2009, 2010, and 2014." "Based on the 2014 survey results, we now believe that what we delineated as warbler habitat on the Bliss Spillar property should at best be considered irregularly occupied habitat." "Surveys have demonstrated that golden-cheeked warblers occur more often, but still irregularly, on the

Tabor property to the west of the SH 45SW ROW." "Surveys performed on behalf of the City of Austin have shown that portions of this patch of woodland are, in fact, occupied by golden-cheeked warblers, but not on an annual basis."

"All field surveys performed to date have failed to result in detection of golden-cheeked warblers within the SH 45SW ROW, strongly suggesting that no habitat used by warblers is present within the actual boundaries of the ROW."

Re: Bear Creek and west of the Bliss Spillar property …"Applying the findings of Magness et al. (2006), more than enough woodland is present on the local landscape to attract golden-cheeked warblers to this area."

"Despite the distribution of potential golden-cheeked warbler habitat as modeled by Morrison et al. (2010) and shown on Figure 3, SWCA believes it is highly likely that no golden-cheeked warblers occur regularly to the east of the SH 45SW ROW in southern Travis County. **[isn't this where Lisa found that GCWA family group??]** Regularly occurring populations of the golden-cheeked warbler are located west of the SH 45SW ROW as demonstrated by surveys conducted on lands owned by the City of Austin (SWCA 2013), with those birds occurring in habitat contained within the large, dark green polygon shown on Figure 3. If golden-cheeked warblers prefer to be close to members of their own kind, then it would make sense that any golden-cheeked warbler looking to settle in southern Travis County would choose to establish a territory farther to the west where they would have opportunities to interact with other warblers, instead of in an isolated patch of woodland along the SH 45SW corridor that is devoid of members of their own kind, regardless of the character of the woodland."

**P.25 Overall assessment not well-substantiated:** "Because no golden-cheeked warblers were present in or directly adjacent to the SH 45SW ROW in 2014, no direct or indirect impacts to individual golden-cheeked warblers would be expected to occur."

**"**Studies performed on the possible effects of road construction noise on golden-cheeked warblers have demonstrated that road construction noise has no effect on golden-cheeked warbler pairing success, territory placement, or productivity (Lackey et al. 2011, Pruett et al. 2014). Consequently, should a male golden-cheeked warbler choose to establish a territory in proximity to the SH 45SW ROW while highway construction was underway, that construction would not be expected to impair the ability of that warbler to attract a mate or impair the ability of a pair of warblers to successfully raise young. Because vegetation clearing activities within the SH 45SW ROW are expected to be performed outside of the golden-cheeked warbler breeding season and because studies have shown that road construction noise does not affect golden-cheeked warbler pairing success or productivity, no direct impacts to golden-cheeked warblers are expected as a result of construction of SH 45SW."

**p. 26:** "Examples of specific locations where golden-cheeked warblers occur next to roads are too numerous to list, but SWCA has observed the species directly adjacent to roads of all types and traffic loads, including at two different locations within the median of Interstate Highway 10 (SWCA 2012)."

**Much weight given to Pruett et al 2014 and Lackey et al 2011:** "studies performed by Lackey et al. (2011) and Pruett et al. (2014) indicate that noise generated by post-construction use of SH 45SW should not be expected to impair the ability of any golden-cheeked warblers to find mates or successfully raise young, should they choose to settle in proximity to the completed highway. Thus, based on the above, no indirect impacts to those golden-cheeked warblers would be expected to result

from presence and use of the highway." However, as noted herein these studies lack scientific rigor, thus not without significant problems in their utility to fully understand the problem.

Fig. 5 of SWCA report shows result of post-highway impact on GCWA habitat. They retain SWCA 2013 sightings in Bliss Spillar east of ROW but in absence of habitat… seems counterintuitive..

**Lackey at al. 2011.** Problems discussed here are in common among Lackey et al., 2011, 2012; Pruett et al. 2013, Davis et al. 2014, Long et al. 2015:

I. **Reproductive Success.** The use of the term 'reproductive success' (RS) here is not defined but this paper is one of many in the pantheon of applied science that have co-opted and simplified the term which is a measure of an individual's ability to pass on genes to future generations. Most scientists base the definition on a relative understanding of initial output (e.g., eggs, nestlings) versus an observation at some future time. As such, most (see Lincoln et al, 1982) define the term as: "The number of offspring of an individual surviving at a given time." Thus, it must involve measurement of that individual's offspring's ability to put genes into future generations. This is critically important in determining an individual's biological fitness, key to understanding natural and sexual selection in evolutionary theory. Measuring biologically meaningful RS is time-consuming. Many consultant-level researchers take a short cut and simply measure the number of individuals raised to maturity and assume these offspring will also reproduce successfully, but this is validated. What they are measuring here is, at best, a preliminary guess based on the presence of a fledgling, at one point in time, in a territory. It is a sample size of n=1, statistically meaningless. This cannot be construed as success since the fate of that one bird is unknown. But even if it were known the use of an index that refers to a territory as 'successful' based on sighting one fledgling has no indication of how many eggs/nestlings produced that lone bird. Was that bird the lone hatchling of a clutch of one egg? Or was it the lone survivor of a clutch of 4 eggs and 4 nestlings? These outcomes are vastly different and biologically meaningful, and they are not examined in this paper which purports to assess impact to 'reproductive success.'

   Regardless, use of Vickery Reproductive Index (RI) for reproductive success is highly controversial for reasons stated above. Methods, p.17 (Lackey et al., 2011): "We considered territories successful if adults were seen with fledglings 1 time, and unsuccessful if the male was observed with a female 1 time but we did not find fledglings in the territory." Many factors are responsible for not finding fledglings, additionally if clutch size and hatching success are unknown (as in this study) then no way of confidently assessing reproductive success. Morgan et al (2010) regards the Vickery RI as a 'coarse indicator of habitat suitability' and Reidy et al (2015) demonstrated its unreliability for GCWA. This analysis should be discounted for its lack of defensibility.

II. **Use of Minimum Convex Polygon method.** Bias is well-known in the literature (Burgman and Fox, 2003; Barg et al 2005). This method is a poor substitute for intensive territory mapping, it is much more informative to examine core use areas (see Fig. 4 below, Barg et al. 2005). Using 'centroids of MCP territories, as done in Lackey et al 2011, and others, does not yield an accurate assessment of actual habitat use. Territory size determined by MCP as the perimeter of outermost locations increases proportionately with sample size. Thus, territory size will increase in direct proportion to sample size. MCP does not take into account areas of most intensive

use, the areas of 'core activity.' Since the study relies on MCP-based territory 'centroids' for evaluating territory shifts at varying distances from road construction one is left with the feeling that the question of impact was not fully addressed.

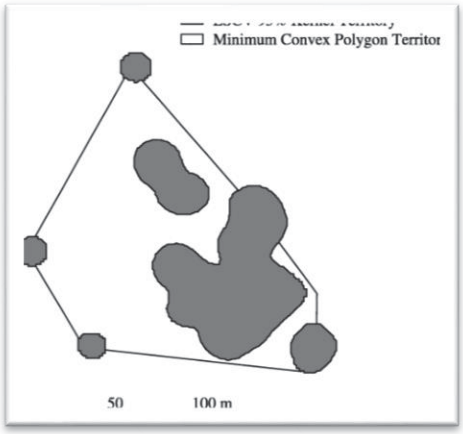


**Fig. 4.** Territory boundaries for a *Dendroica cerulea* male generated by the fixed kernel density estimator (shaded area) and the minimum convex polygon (outline). Areas enclosed by the minimum convex polygon that do not overlap with the kernel boundaries were contiguous forest habitat, but the individual was never recorded there.

III. **Density estimation.** (p. 17; Lackey et al, 2015) "For density calculation, we divided total number of territories by estimated area surveyed to determine territorial males/ha for each of the study sites in all years." This approach to density estimation is not supported by the literature (Buckland et al 2001), there is no estimate of variance, no statistical power from lack of sample size estimation.

IV. **Lackey et al 2011 conclusion** (similarly concluded in Lackey et al., 2011, 2012; Pruett et al. 2013, Davis et al. 2014, Long et al. 2015)**,** that "we did not detect any impact of construction noise, nor road proximity, on the reproductive success of golden-cheeked warblers." is based on a minimal, 'quick and dirty' approach, therefore lacking in rigor and of limited merit.

**Long et al. (2015)** states in the Introduction (italics mine):

"…it is critically important that we accurately identify the indirect factors accompanying these activities *[roadway noise effects on bird breeding and survival]*, especially for species classified as threatened or endangered." This study tackled a large number of variables, but seemed a bit too ambitious, it reports results on ambient noise, surveying for birds, banding birds, mapping and monitoring territories, monitoring nests visually, and with cameras, monitoring nest behavior, playback of recorded noise, and analyses of GCWA song responses over several seasons (2009-2014). On the surface it seems comprehensive but aspects of the methodology (e.g., Vickery RI, MCP) and low sample sizes hampered the results. Thus their conclusion, that their results "…add to the growing body of literature reporting that roadway noise and construction activities along existing infrastructure do not have a negative impact on the federally endangered golden-cheeked warbler," was at odds with their methodology. Additionally, potential conflict of interest, regarding Long et al 2015 study. Beyond that there are several other problems accepting the validity of the work, not untypical in the field of studies that attempt to answer these difficult questions. First, they tend, due to expediency in time and funding, to rely on estimators with an unfavorable degree of error in estimation, such as using the widely disputed Vickery Method for estimating productivity (see Reidy et al., 2015. Evaluation of a reproductive index for estimating songbird productivity: Case study of the golden-cheeked warbler. Wildlife Society Bulletin. Vol. 39: 721–731). Additionally, minimum convex polygon (MCP) method is used for delineating territories. This method - although relatively easy and attractive for the same reasons researchers

use the Vickery Method - is fraught with bias (Burgman, M. A. and J. C. Fox. 2003. Animal Conservation Vol 6: 19–28) This feeling is rampant with studies like that of Long et al 2015. Long et al 2015 also looked at 'acute' responses to behavioral changes when presented with recorded road noise. Problems here include not presenting the birds with a meaningful source of disturbance (see Pater et al. 2006. Recommendations for Improved Assessment of Noise Impacts on Wildlife. Journal of Wildlife Management. 73: 788-795.), and not measuring factors (e.g., physiological stress) which have long term impacts on population viability (see Ware et al. 2015. A phantom road experiment reveals traffic noise is an invisible source of habitat degradation. Proceeding National Academy of Sciences www.pnas.org/cgi/doi/10.1073/pnas.1504710112).

The above misgivings notwithstanding, Long et al 2015, and others seeking to quantify 'effects' on GCWA due to road noise, typically make an overall assessment of 'no significant negative impacts' even though a few may be worth noting.

**Noise studies along Hwy 71:**

**Pruett et al (2014) cited in SWCA report was not available to me. Nearest similarity would be:**

**Pruett et al 2013. ANALYSIS OF THE GOLDEN-CHEEKED WARBLER IN RELATION TO CONSTRUCTION ACTIVITY ALONG HIGHWAY 71. IRNR Summary 2013 for TNC.**

- Compare direct impacts of highway construction noise on measures of reproductive success.
- We conducted transect surveys, mapped and monitored territories, and monitored nests to determine (1) pairing success, (2) territory fledging success, and (3) nest success and predation events.
- Quantify behavioral responses of golden-cheeked warblers to construction activity and noise.
- We examined behavioral responses of adult golden-cheeked warblers to construction noise and activity by (1) assessing territory establishment using measures of territory density, location of territories relative to the ROW, and returns of banded birds in subsequent breeding seasons; (2) recording adult activity patterns at the nest using digital video recorders; (3) determining the initial behavioral response to recordings of construction noises using an experimental design (hereafter playback experiment); and (4) recording vocalizations of territorial males to determine if golden-cheeked warblers alter their vocalizations to account for construction noise and activity.
- As indicated from the study results, evaluate the spatial and temporal extent of highway construction impacts on the study species.
- Make recommendations for alleviating any negative impacts of highway construction noise on warblers.

**Study Area:** Barton Creek Habitat Preserve. 25 Feb – 14 Jun 2013. Pre-treatment data collected 2008-2010 prior to Hwy 71 construction. Construction phase: 2011-2013. Road-noise only site along Southwest Parkway. Control sites on BCHP >1km from Hwy 71.

**Methods:** Used Vickery for Territory monitoring, productivity surveys (p. 3). No confidence in Vickery for reasons above.

**Birds banded:**

- "To examine movement of breeding birds between years, we banded a subsample of adults within the study sites and conducted band resights in subsequent years."

**ARUs deployed:** 9 to "gather audio data on warbler song type and frequency from 26 March 2012 through 28 May 2013."

**Recorded ambient noise:** "We also measured ambient noise levels using 12 data-logging sound meters along 5 transect pairs positioned perpendicular to the road, spaced according to the inverse square law; i.e. at intervals of approximately 16m, 32m, 64m, 128m, 256m, and 512m (Fig. 2). Sound meters recorded for approximately 24 hours. We relocated sound meters twice a week from 27 March
2012 to 30 May 2013.

**Playback:** "To examine the **initial behavioral response** of territorial birds to loud, erratic construction noises, we played recordings of construction noise to male warblers. We recorded behavior for 1-2 minutes before playback, and **then broadcasted construction noise with a hand-held speaker for**
**1–5 seconds**." "We considered a playback experiment to have elicited a behavioral response if the warbler ceased singing, flew from its previous perch **and** out of the surveyor's view (≥10 m) or changed behavior before or exactly at the end of hearing 5 seconds of construction noise."
Statistical Analysis (p. 4)." We determined productivity for each warbler territory. We considered males unpaired if we never observed them with a female, paired if we observed them with a female, and successfully fledged if we detected at least one host fledgling with a pair. We used minimum convex polygons in ArcMap 9.3 to determine the density of territories in each study site (Fig. 3). We used the centroid point for each territory polygon to determine territory placement in relation to the right of way in each study site." **SAME PROTOCOL AS IN LACKEY ET AL 2011, LONG ET AL 2015. No indication here of how many detections used to delineate MCPs…**

**Pruett et al 2013 was a field season summary, not a final product.**.

no overall summary presented other than what happened that year. A small number of playback responses were elicited: "We conducted 51 construction noise playback surveys and 25 control playback surveys. Of these surveys, 4 elicited a response; 3 construction noise playback surveys and one control playback survey. Of the construction noise playback surveys, two responses were in the construction study site at 575 m, and 650 m from the ROW and one response occurred in the road-noise only site at 485 m from the ROW. The one control playback survey that resulted in a response occurred in the construction study site 292 m from the ROW."

**Davis et al (2014). This appears to be the 2014 field season of above project (Pruett et al 2013) and now has different lead author (Kristin Davis), Pruett no longer an author.**

**Playback results here, showed responses to noise:** "We conducted 78 construction noise playback surveys and 22 control playback surveys. Of these surveys, 15 playback surveys elicited a response (14 construction noise playback surveys and one control playback survey). **Of the**

**construction noise playback surveys, seven responses were in the construction study site between 95 m and 396 m from the ROW and seven responses occurred in the road-noise only site between 230 m and 788 m from the ROW. The one control playback survey that resulted in a response occurred in the road-noise only study site 253 m from the ROW."**

**NO FINAL SUMMARY OF THIS PROJECT AVAILABLE… although Long et al seems to sum up these field season data that were *collected ostensibly for TNC*???**

**Long et al 2015. Oddly, no mention of Pruett 2013, or Pruett 2014 (cited in SWCA), but project encompasses 2009-2014 at BCHP and Southwest Parkway… was this a different study?**

- Same overall method, Vickery, MCPs… little confidence in those methods.

| Reference | MCP | Vickery RI |
|---|---|---|
| Lackey et al., 2011 | X | X |
| Lackey et al., 2012 | X | X |
| Long et al., 2015 | X | X |
| Pruett et al., 2013 | X | X |
| Pruett et al., 2014 | Presumed | Presumed |
| Davis et al., 2014 | X | X |

**Benson, R. H. (1995) review:**

- Designed to 'estimate' sound levels at randomly selected sites as designated listening posts where observers would then visit to record presence/absence of GCWA.
- This design involves no empirical data on sound, only computer generated approximations based on computer model (STAMINA 2.0, since updated by Federal Highway Administration). The model, in turn, did not incorporate real sound data, only projected estimates of vehicular traffic based on counting instruments placed across State Hwy 22/FM 1473 at extreme northeast corner of Meridian State Park.
- Locations of listening posts generated randomly. Finding these during field visits could prove problematic since during year (1994) of study GPS data were scrambled and had to be post-processed for accuracy. Author elected not to post process the GPS points so no way to determine accuracy of locations compared to model-generated 'listening post' data.
- "Listening post" is a computer-generated point, has no vertical dimension. Sound is attenuated differently based upon many physical factors across vertical strata, soil type, environmental barriers and topography. If GCWA sings high and listening post/sound level estimate is low then 'listening post' loses value? No error quantified here.
- One visit per post. Would have been stronger to include greater number of visits per post (if posts could be accurately located, see above).
- Visits involved 20 minute data collection. Recent research (Peak 2011) recommends 2 minutes to avoid over-estimates.
- Highest noise 'estimated' to be 58.6 dB; these are estimates based on a computer model, not empirical data collected at the listening posts.

**A critical point to be made about 'noise studies':** effects are likely broadscale and long term. While GCWA is focus of this assessment, many other wildlife species could be affected.

**See:** Ware, H. E., C. J. W. McClure, J. D. Carlisle, and J. R. Barber. 2015. A phantom road experiment reveals traffic noise is an invisible source of habitat degradation. *PNAS* doi: 10.1073/pnas.1504710112. Abstract and Significance excerpted below:

*Abstract:*

Decades of research demonstrate that roads impact wildlife and suggest traffic noise as a primary cause of population declines near roads. We created a "phantom road" using an array of speakers to apply traffic noise to a roadless landscape, directly testing the effect of noise alone on an entire songbird community during autumn migration. Thirty-one percent of the bird community avoided the phantom road. For individuals that stayed despite the noise, overall body condition decreased by a full SD and some species showed a change in ability to gain body condition when exposed to traffic noise during migratory stopover. We conducted complementary laboratory experiments that implicate foraging-vigilance behavior as one mechanism driving this pattern. Our results suggest that noise degrades habitat that is otherwise suitable, and that the presence of a species does not indicate the absence of an impact.

*Significance*

Using landscape-scale traffic noise playbacks to create a "phantom road," we find that noise, apart from other factors present near roads, degrades the value of habitat for migrating songbirds. We found that nearly one third of the bird community avoided the phantom road. For some bird species that remained despite noise exposure, body condition and stopover efficiency (ability to gain body condition over time) decreased compared with control conditions. These findings have broad implications for the conservation of migratory birds and perhaps for other wildlife, because factors driving foraging behavior are similar across animals. For wildlife that remains in loud areas, noise pollution represents an invisible source of habitat degradation.

**Other Literature Cited above:**


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Blickley JL, Word KR, Krakauer AH, Phillips JL, Sells SN, et al. (2012) Experimental Chronic Noise Is Related to Elevated Fecal Corticosteroid Metabolites in Lekking Male Greater Sage-Grouse (*Centrocercus urophasianus*). PLoS ONE 7(11): e50462. doi: 10.1371/journal.pone.0050462

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Brumm, H. 2013. Animal communication and noise. Springer, Heidelberg.
--CANNOT LOCATE, not included in this review, but probably similar if not same dataset as that in Long et al (2015) below – note same exact TxDOT contract. Perhaps also related to Pruett et al (2013) and Davis et al (2014) below. If so, then likely study area was: Barton Creek Habitat Preserve; US HWY 71, near Southwest Pkwy.

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http://onlinelibrary.wiley.com/doi/10.1017/S1367943003003044/abstract
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https://www.fhwa.dot.gov/publications/publicroads/03jul/06.cfm - "Levels of highway traffic noise typically range from 70 to 80 dB(A) at a distance of 15 meters (50 feet) from the highway. "

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Texas Parks and Wildlife Department (TPWD). 2015. Comments on Texas Department of Transportation (TxDOT) Final Environmental Impact Statement (FEIS) for State Highway (SH) 45. Texas Parks and Wildlife Department, Habitat Assessment Program. Austin, TX.

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